

brighter coloured than the back. A bright yellow streak behind each ear and a conspicuous bright yellow stripe running internally down the front of the thigh to the hock. Anterior surface of legs covered to the digits with hairs speckled yellow and black.

Loc. Peru.

One specimen (type) presented to the Zoological Society by Mr. B. Chavez, who brought it from the "Amazons." A second procured by Mr. A. E. Pratt on the Marona River, Peru.

In *Myoprocta acouchy*, Linn., from Guiana, the hairs are speckled with rich rusty yellow, and many of those on the hind-quarters are wholly black, the underside is rusty orange all over, and the fronts of the legs are almost the same colour as the belly and unspeckled.

XVII.—*The Classification of the Percoid Fishes.*

By C. TATE REGAN, M.A.

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THE large and varied order Percomorphi occupies a central position among the Teleostean fishes. On the one hand it appears to be derived from the Berycomorphi, and on the other it seems to have given rise to a number of specialized offshoots, which may be regarded as ordinally distinct: Scleroparei, Heterosomata, Plectognathi, Discocephali, Xenopterygii, Pediculati, Symbranchii, and Opisthomi.

The Percomorphi may be thus defined:—

"Symmetrical acanthopterous physoclists with normal dorsal fin, pelvic fins never more than 6-rayed, subabdominal, thoracic, jugular, or mental in position, the pelvic bones typically attached to the cleithra; principal caudal rays not more than 17. No orbitosphenoid. Second suborbital not forming a stay for the præoperculum. Posttemporal more or less distinctly forked."

At present I am inclined to recognize thirteen suborders, viz. Percoidae, Trichiuroideae, Scombroideae, Siganoideae, Teuthidoideae, Kurtoideae, Gobioidae, Blennioideae, Stromateoideae, Anabantoideae, Mugiloideae, Polynemoideae. But it is largely a matter of opinion whether some of these may not be regarded as ordinally distinct, or whether others should not rank merely as divisions of the Percoidae.

I have already dealt with the Trichiuroideae, Scombroideae,

Gobioidea, and Blennioidea, and have given some account of the Anabantoidea and Stromateoidea, whilst Starks has described the osteology of the Mugiloidea.

The present paper deals mainly with the Percoidea, the most generalized suborder, defined by the absence of the special peculiarities which characterize the other suborders of the Percomorphi.

The limits and contents of the Percoidea are indicated in the following scheme :—

Suborder PERCOIDEA.

1. *Perciformes*: Serranidæ, Pseudoplesiopidæ, Plesiopidæ, Kuhlidæ, Centrarchidæ, Priacanthidæ, Chilodipteridæ, Percidæ, Sillaginidæ, Latilidæ, Lactariidæ, Bathyclupeidæ, Labracoglossidæ, Pomatomidæ, Rha-chicentridæ, Carangidæ, Menidæ, Bramidæ, Coryphænidæ, Centropomidæ, Arripididæ, Erythrichthyidæ, Lutianidæ, Nemipteridæ, Lobotidæ, Liognathidæ, Pomadasidæ, Scænidæ, Mullidæ, Lethrinidæ, Sparidæ, Mænidæ, Monodaetylidæ, Pempheridæ, Toxotidæ, Scorpididæ, Cyphosidæ, Girellidæ, Ehippidæ, Drepanidæ, Chætodontidæ, Scatophagidæ, Euplosidæ, Histiopteridæ, Pristolepidæ, Nandidæ, Cichlidæ, Hopleguathidæ, Cepolidæ.
2. *Cirrhitiformes*: Cirrhitidæ, Chironemidæ, Haplodactylidæ, Chilodactylidæ, Latrididæ.
3. *Pomacentriformes*: Pomacentridæ.
4. *Labriformes*: Labridæ, Odacidæ, Scaridæ.
5. *Embiotociformes*: Embiotocidæ.
6. *Gadopsiformes*: Gadopsidæ.
7. *Trichodontiformes*: Trichodontidæ.
8. *Ammodytiformes*: Ammodytidæ.
9. *Champsodontiformes*: Champsodontidæ.
10. *Trachiniformes*: Opisthognathidæ, Bathymasteridæ, Pinguipedidæ, Chimarrhichthyidæ, Trachinidæ, Percophiidæ, Bembropsidæ, Hemerocætidæ, Trichonotidæ, Creediidæ, Linnichthyidæ, Leptoscopidæ, Uranoscopidæ.
11. *Nototheniiformes*: Bovichthyidæ, Nototheniidæ, Bathydraconidæ, Chænichthyidæ.
12. *Callionymiformes*: Callionymidæ, Draconettidæ.

Division 1. PERCIFORMES.

Spinous dorsal fin usually well developed. Pelvic fins usually thoracic, of a spine and 4 or 5 soft rays; pelvic bones directly attached to cleithra. Mouth typically protractile, the præmaxillaries with more or less developed pedicels, and nearly always free from the maxillaries. Hyopalatine and opercular series of bones all present. Lower pharyngeals not ankylosed. Parietals present, separated by supraoccipital: opisthotic well developed; a basisphenoid usually present. Post-temporal forked; pectoral radials hourglass-shaped, four in number, the lowest and sometimes part of the next on the hypocoracoid.

In the following arrangement a few of the more aberrant families are placed last, and the remainder are grouped into those without (*Serranidæ* to *Coryphænidæ*) and those with a scaly process in the axil of the pelvic fins.

Fam. 1. *Serranidæ*.

Spinous dorsal usually well developed; anal spines usually 3; caudal usually with 17 principal rays, 15 branched (15, 13 branched, in *Anthias*); pelvics thoracic, each of a spine and 5 branched rays, without axillary process. Two nostrils on each side. Gill-membranes free from the isthmus; 5 to 8 branchiostegals; 4 gills; pseudobranchiæ usually present. Mouth protractile; villiform or cardiform teeth in the jaws and usually on the palate; each præmaxillary ramus with a posterior process or expansion internal to the maxillary; latter broadest distally, usually exposed, rarely sheathed by the præorbital. A subocular shelf. Two postcleithra on each side. Vertebrae 24 or more; first 2 or more præcaudals without parapophyses; some or all of the ribs inserted on parapophyses.

It may be noted that in *Callanthias* and *Therapon* all the ribs are inserted on parapophyses*, and that those of the genus *Morone* are rather exceptional in their insertion. In this genus the vertebrae number 25, the præcaudals with parapophyses from the third or fourth; of the 10 pairs of ribs the last 3 to 5 (according to the species) are distinctly inserted on the parapophyses, but it is rather a matter of personal opinion as to how many of the remainder are sessile; they may be described either as inserted on the centra below and behind the parapophyses, or as on the

* Thus forming an exception to the statement made on p. 653 of the 'Cambridge Natural History, Fishes.'

bases of the parapophyses at their origin from the centra. Practically the same structure is seen in *Kuhlia*.

To the Serranidæ I would add *Acropoma*, which has a subocular shelf, *Malacichthys*, probably related to *Acropoma*, and *Dæderleimia* (*Anthias berycoides*, Hilgend.). Two fine examples of this species are in the British Museum Collection, and a skeleton has been made of one of them; the fish is typically Serranid. *Diploprion*, with 2 anal spines, and *Hapalogenys*, with toothless palate, are typical Serranids in other characters. *Therapon*, placed by Boulenger in the Lutianidæ, has no pelvic axillary process.

The Pseudochromididæ do not seem to me deserving of family rank. Except for the 2 lateral lines they are typical Serranidæ, and *Pseudogramma*, with the spinous and soft-rayed portions of the dorsal fin subequal, connects *Gramma* with *Pseudochromis* and *Cichlops*.

Fam. 2. Pseudoplesiopidæ.

The aberrant genus *Pseudoplesiops* differs from the Pseudochromidinae in that the lower lateral line is absent, the dorsal and anal have but a single spine each, and the articulated rays of the pelvic fins are unbranched, 4 in number.

Fam. 3. Plesiopidæ.

General characters of the Serranidæ, but the pelvic rays reduced in number, I 2-4, the first soft ray simply bifid.

The genera may be arranged thus:—

- I. Pelvics I 4, below or slightly in advance of the pectorals; anal spines 3. A subocular shelf. Two lateral lines.
 First soft ray of pelvic not thickened or produced *Trachinops*.
 First soft ray of pelvic thickened and produced;
 third and fourth small and slender *Plesiops*, *Paraplesiops*.
- II. Pelvics I 2, well in advance of the pectorals, the first soft ray thickened and produced; anal spines numerous. No subocular shelf.
 Scales large; one lateral line *Acanthoplesiops*.
 Scales small; 3 or 4 lateral lines *Acanthoclinus*.

Fam. 4. Kuhliidæ.

Kuhlia differs from the Centrarchidæ in the presence of pseudobranchiæ, the absence of parietal crests, and the different insertion of the ribs. Vertebrae 25 (10+15); præcaudals with parapophyses from the third or fourth;

first 4 or 5 ribs sessile, inserted below and behind the parapophyses; last 3 or 4 on the parapophyses.

In the structure of the vertebral column and the attachment of the ribs *Kuhlia* shows far more resemblance to *Morone* than to the Centrarchidæ. Other characters confirm its relationship to *Morone*, and make it probable that it is derived from Serranidæ of the type of that genus.

Fam. 5. Centrarchidæ.

After the removal of *Kuhlia* this is a very natural and well-defined family, closely related to the Serranidæ, but distinguished by the vestigial or absent pseudobranchiæ, the absence of a subocular shelf, and the different attachment of the ribs. Vertebrae 25 to 33; præcaudals with transverse processes from the third or fourth; ribs mostly sessile, inserted high up on the centra or on the bases of the neural arches, above and behind the parapophyses.

Fam. 6. Priacanthidæ.

Differ from the Serranidæ especially in the reduced number of vertebrae, 23 (10 + 13), the first very short and firmly adherent to the skull, the absence of a basisphenoid, and the single postcleithrum. Caudal with 16 principal rays, 14 branched.

Fam. 7. Chilodipteridæ.

This family includes fishes with the general characters of the Serranidæ, but with only 2 anal spines. A separate spinous dorsal of 5 to 9 spines. Jaws with villiform teeth, sometimes with canines: teeth on vomer and palatines. An occipital crest; parietal crests feeble or absent. Vertebrae 24 to 27 (10-11 + 14-17); præcaudals with parapophyses from the fifth or sixth; first 3 or 4 ribs sessile.

Principal genera: *Apogon*, *Apogonichthys*, *Chilodipterus*, *Epigonus*, *Synagrops* (*Parascombrops*, *Melanostoma*), *Dinolestes*.

A subocular shelf is present in *Chilodipterus* and many species of *Apogon*, but not in *Apogon maximus* or in *Epigonus*; *Synagrops*, which is the nearest to *Dinolestes* in the dentition, the scaly fins, &c., has a rather feeble shelf, but *Dinolestes* has none.

A good account of the osteology of *Dinolestes* has been given by Starks (Proc. U.S. Nat. Mus. xxii. 1899, pp. 113-120, pls. viii.-xi.).

Fam. 8. Percidæ.

Especially distinguished from the Serranidæ by the absence of a subocular shelf and by having only 1 or 2 anal spines. Vertebrae 30 to 48.

In some species of *Percina* and *Etheostoma* I find the principal caudal rays number 17 (1/15/1); in others belonging to *Boleosoma* and *Ammocrypta* there are 16 (1/14/1). I have not fully investigated this, but the character will probably be found of some taxonomic value.

Fam. 9. Latilidæ.

Dorsal continuous, with the spinous portion much less extended than the soft or than the anal; latter with 1 or 2 spines; caudal of 17 principal rays, 15 branched; pelvics thoracic, each of a spine and 5 soft rays, without sealy axillary process. Mouth terminal, protractile; villiform teeth in the jaws; often a canine near the distal end of the præmaxillary; palate toothless; posterior expansions of præmaxillary rami reduced; maxillary exposed distally, without supramaxillary, with a proximal posterior expansion more or less developed. A subocular shelf. Gill-membranes united, but free from the isthmus; 6 branchiostegals; 4 gills; pseudobranchiæ present; lateral line complete, continuous. Occipital and parietal crests present, variously developed. Vertebrae 24 to 27 (10-12 + 14-15); præcaudals with parapophyses from the first or third; all the ribs on parapophyses.

Fam. 10. Sillaginidæ.

Spinous dorsal separate, of slender spines, less extended than the soft dorsal or anal; later with 2 spines. Teeth on the vomer; jaws normally formed; maxillary concealed beneath the expanded præorbital. Vertebrae 33 (15 + 18); præcaudals with parapophyses from the third; all the ribs on parapophyses. In all other characters essentially similar to the Latilidæ.

Fam. 11. Lactariidæ.

Lactarius has the general characters of the Serranidæ, but there is no subocular shelf, the spinous dorsal is short, separate, of slender spines, and the soft dorsal and anal are long, covered with small scales. Mouth terminal, oblique, with the lower jaw prominent; maxillary exposed, with

supramaxillary; jaws with small pointed teeth and anterior canines; teeth on vomer and palatines. Upper surface of head with large muciferous cavities, bordered by the parietal crests, which are continued forward to the anterior extremity of the frontals. Vertebrae 24 (10+14); last 5 præcaudals with downwardly directed parapophyses; 4 ribs sessile, 4 on parapophyses.

Fam. 12. Bathyclupeidæ.

Bathyclupea, sometimes associated with *Pempheris*, differs from it externally in that the dorsal fin lacks spines and there is but a single anal spine, as well as in the presence of a supramaxillary; the skeleton differs in that the hypocoracoids are narrowed forward below and the vertebrae number 31 (10+21). It seems probable that *Bathyclupea* is related to *Lactarius*, from which it differs especially in the absence of the spinous dorsal fin and the presence of a subocular shelf.

Fam. 13. Labracoglossidæ.

The genera *Labracoglossa* (*Cypselichthys*), *Bathystethus* (*Platystethus*), and *Evistius* have the fins formed as in *Lactarius*, except that the dorsal is continuous. Mouth terminal, oblique, with the lower jaw included; maxillary exposed, without supramaxillary; minute teeth in the jaws, without canines; palate with or without teeth. No large muciferous cavities on the head, the parietal crests, if developed, commencing behind the orbit, not extending forward in advance of the insertion of the trunk-muscles. No subocular shelf.

I have examined spirit-specimens, and, judging by the distance between the ribs, I estimate that the vertebrae number 24 in all 3 genera.

Fam. 14. Pomatomidæ.

Scarcely distinct from the Serranidæ, but the separate spinous dorsal of a few slender spines, and the first anal spine very small, often overgrown. Præoperculum with a membranous flap produced over the suboperculum. Vertebrae 26 (10-11+15-16); præcaudals with downwardly directed parapophyses from the sixth; first four ribs sessile; rest attached near the extremities of the parapophyses.

In *Pomatomus* (*Temnodon*) and *Scombrops* (incl. *Telescopias*) scales are present, the soft dorsal and anal are

densely scaly, the jaws have a series of strong pointed teeth, with a few inner teeth anteriorly in the upper, smaller teeth are present on the vomer and palatines, a supramaxillary is present and is rather abnormal in form, having a well-marked projection superiorly. *Gymnapogon* (Regan, Ann. & Mag. N. H. (7) xv. 1905, p. 19) is near *Scombrops*, but there are no scales and the supramaxillary is absent.

Fam. 15. Rhachicentridæ*.

The spinous dorsal of a few short free spines and the long soft dorsal and anal distinguish *Rhachicentrum* from the Serranidæ; the skull is depressed, flattish above, with the exoccipital condyles wide apart, and there is no subocular shelf; otherwise the skeleton is Serranid.

Fam. 16. Carangidæ.

Differ from the Serranidæ in the shorter spinous dorsal, with the spines slender or short, the longer soft dorsal and anal, the detachment of the two first anal spines from the rest of the fin, the more widely forked caudal, with the bases of the rays embracing the hypurals to a greater extent, and the more slender caudal peduncle. Head-skeleton and pectoral arch as in the Serranidæ. Vertebrae usually 24 (10+14) (10+15 in *Naucrates*, 10+16 in *Scombroides*, 10+17 in *Paropsis*). In *Seriola*, *Caranx*, and their allies, the anterior ribs are sessile and most of the ribs are inserted on parapophyses when these are developed, but in *Trachynotus*, *Lichia*, *Paropsis*, *Scombroides*, &c., parapophyses are developed from the third or fourth vertebra, but the ribs, except the last two pairs, are sessile.

Fam. 17. Menidæ.

The very aberrant *Mene* may perhaps be related to the Carangidæ, from which it differs externally in the absence of dorsal and anal spines. The inner apophyses of the maxillaries are compressed into vertical laminae, with their lower edges articulating in a pair of parallel grooves separated by a median ridge on the antero-superior surface of the vomer; a similar arrangement occurs in the Carangid *Micropteryx*. There is a strong occipital crest; the post-orbital part of the skull is elevated and the epiotics meet behind the supraoccipital. There are 23 vertebrae (9+14);

* Cf. Regan, Ann. & Mag. Nat. Hist. (8) iii. 1909, p. 68.

the enlarged first pair of ribs articulate with the post-cleithra, are sessile on the third vertebra, and are supported by the strong parapophyses of the fourth and fifth vertebrae; the other ribs are inserted on parapophyses.

Fam. 18. Bramidæ.

Dorsal and anal fins long, without true spines, but with a few of the anterior graduated rays non-articulated; caudal fin as in the Carangidæ; scales large. Skull with parallel occipital and parietal crests extending to the anterior edge of the frontals as in typical Carangidæ, but the former very high and with the edge nearly vertical anteriorly; mesethmoid hollowed out for the vertical præmaxillary pedicels; no subocular shelf. Vertebrae 42 to 47; most of the ribs at the extremities of closed hæmal arches.

Some species of *Seriola* approximate very closely to *Brama* in cranial structure.

Fam. 19. Coryphænidæ.

Differ from the Bramidæ in the small scales and in the structure of the vertebral column; 30 to 33 vertebrae, the præcaudals without parapophyses, the ribs and epipleurals inserted together on the centra.

Fam. 20. Centropomidæ.

Closely related to the Serranidæ and Lutianidæ. Spinous and soft portions of the dorsal separate or united, subequal, the former of 7 to 9 strong spines; anal as long as or a little shorter than soft dorsal, with 3 spines; pelvic with a scaly axillary process. Mouth moderately protractile; teeth acute or obtuse, in jaws and on vomer and palatines; maxillary exposed. Subocular shelf broadest posteriorly. Lateral line extending on caudal fin. Vertebrae 24 or 25 (10-12 + 13-15); anterior præcaudals without parapophyses; first 3 to 5 ribs sessile.

The genera may be arranged thus:—

I. Parietal and occipital crests; operculum ending in a spine; a supramaxillary; a continuous dorsal fin; 25 vertebrae.

Glaucosoma, Psammoperca, Lates.

II. An occipital, but no parietal crests; frontals with strongly developed muciferous channels; operculum without spine; præoperculum with a double ridge; 24 vertebrae.

A. Dorsals separate; a supramaxillary *Centropomus.*

B. Dorsals connected; no supramaxillary . . . *Ambassis.*

Fam. 21. Arripidiæ.

Arripis scarcely deserves to be placed in a distinct family from *Glaucosoma*, which it resembles in the structure of the mouth, the dentition, the presence of a pelvic axillary process, &c. The spinous portion of the dorsal fin, of 9 slender spines, is much shorter than the extended soft-rayed part, which is considerably longer than the anal. The lateral line ends or becomes indistinct at the base of the caudal fin. Occipital crest short and parietal crests very small; vertebræ 25 (10 + 15); first 5 without parapophyses; first 3 ribs sessile.

The absence of large muciferous channels on the frontals, the broad subocular shelf, the maxillary exposed as in typical Serranidæ and bearing a supramaxillary, the vomerine and palatine teeth, and the 3 anal spines distinguish this genus from the Scianidæ, to which it is only remotely related.

Fam. 22. Erythrichthyidæ.

Mouth toothless, strongly protractile; præmaxillaries normally formed, their pedicels reaching an interorbital depression of the frontals; maxillary very broad, with a well-developed supramaxillary which slips under the præorbital. In other characters essentially Lutianid; vertebræ 24 (10 + 14); first rib sessile, next 4 or 5 on very short parapophyses, last 2 or 3 on well-developed parapophyses.

A single genus, *Erythrichthys*, rather similar to *Arripis* in cranial osteology.

Fam. 23. Lutianidæ.

Spinous dorsal well developed; soft dorsal not much longer than anal; 3 anal spines; caudal with 17 principal rays, 15 branched; pelvis thoracic, each of a spine and 5 branched rays, with a scaly axillary process. Two nostrils on each side. Gill-membranes free from the isthmus; 5 to 7 branchiostegals; 4 gills; pseudobranchiæ present. Mouth protractile; villiform or obtusely conical teeth in the jaws and often on vomer and palatines; each præmaxillary ramus with a posterior process or expansion internal to the maxillary; each maxillary ramus broadest distally, not overlapped externally by the extremity of the præmaxillary, slipping under the præorbital and first suborbital for at least the greater part of the length of its upper edge. Outer face of palatine flattish or concave, without distinct ridge. A

strong subocular shelf. Occipital and parietal crests developed. Vertebrae always 24 (10+14); first 2 to 6 without parapophyses; first 1 to 4 ribs sessile.

Principal genera: *Lutianus*, *Genyoroge*, *Hoplopagrus*, *Aspilus*, *Chaetopterus*, *Odontonectes*, *Cesio*, *Aphareus*, *Aprion*, *Propoma*, *Etelis*, *Verilus*.

Fam. 24. Nemipteridæ.

Dorsal X 9. Anal III 7-8. Palate toothless; maxillary ramus as broad just below its palatine articulation as it is distally; outer face of palatine with a strong ridge from the base of the maxillary process to the pterygoid. Vertebrae 24 (10+14); all the præcaudals with parapophyses and all the ribs on parapophyses. In other characters essentially similar to the Lutianidæ.

Principal genera: *Heterognathodon*, *Nemipterus*, *Scolopsis*.

Fam. 25. Lobotidæ.

Closely allied to the Lutianidæ, but with the palate toothless and with no subocular shelf.

Two genera, *Lobotes* and *Datnioides*; in both the maxillary is sheathed throughout its length and the scaly axillary process of the pelvic fin is developed. The occipital crest does not extend forward on to the frontals, but is elevated and has the anterior edge thickened; the parietal crests are weak. Vertebrae 24 (10+14 in *Datnioides*, 12+12 in *Lobotes*); in *Datnioides* the first 6 præcaudals without parapophyses, the first 4 ribs sessile, the last 4 on parapophyses; in *Lobotes* the first 5 præcaudals without parapophyses, the first 4 or 5 ribs sessile, the last 5 or 6 on parapophyses. In *Datnioides* the præmaxillary pedicels are long and extend to above the posterior margin of the orbit; they lie in a depression of the frontals; in *Lobotes* they are of moderate length and do not reach the frontals.

Fam. 26. Liognathidæ.

Closely related to the Lutianidæ. Dorsal fin depressible in a sheath, with 9 or 10 spines, the first short, the second the longest; soft rays subequal; 2 to 5 anal spines. Pelvies with large axillary processes. Mouth very protractile, the long præmaxillary pedicels lying in a groove or chamber formed by the bifurcation of the occipital crest; maxillary variable in form, but always with the anterior edge curved

more or less in the shape of an **S**; distal extremity exposed; no supramaxillary; palate toothless. Vertebrae 24 (10 + 14); first 3 without parapophyses; first rib sessile, rest on parapophyses.

In *Gerres*, *Eucinostomus*, &c., there are 10 soft rays in the dorsal fin and the second suborbital emits a triangular internal lamina; in *Pentaprion*, *Liognathus*, and *Gazza* there are 15 or 16 soft rays in the dorsal fin, the suborbitals are not or but feebly ossified, and there is no subocular shelf. The two last-named genera differ from the others in their small scales and in having the gill-membranes attached to the isthmus.

Fam. 27. Pomadasidæ.

Closely related to the Lutianidæ, differing especially in the absence of a subocular shelf. Palate toothless, or small teeth on the vomer. Vertebrae 26-27 (10-11 + 16-17), the præcaudals with parapophyses from the third or fourth, the ribs inserted on the parapophyses when these are developed. Outer face of palatine with a ridge along its posterior edge.

Principal genera: *Xenichthys*, *Xenocys*, *Xenistius*, *Parapristipoma*, *Plectorhynchus*, *Boridia*, *Conodon*, *Pomadasis*, *Hæmulon*.

Fam. 28. Sciænidæ.

After the exclusion of *Aripis* this is a very natural group, closely related to the Lutianidæ, differing especially in that the soft dorsal is usually more elongate and the anal has only one or two spines; the scaly axillary process of the pelvic fin may be present or absent. The mouth is formed as in the Lutianidæ, the maxillary without a supramaxillary, either concealed or at least slipping under the præorbital and first suborbital for the entire length of its upper edge; the teeth in the jaws are usually villiform, sometimes lanceolate; the palate is toothless. Muciferous channels are well developed on the upper surface of the head; the subocular shelf, when present, is a small and usually slender process of the second suborbital. The vertebrae number 24 to 30; the anterior præcaudals without parapophyses and with sessile ribs, the posterior ribs inserted on parapophyses.

The genera of this very varied family are numerous (cf. Jord. & Everm. Fish N. Am. p. 1392).

Boulenger's definition, that the anal is much shorter than the soft dorsal, does not hold good. *Seriphus*, Ayres, with the anal fin rather longer than the soft dorsal, has the skeleton of a typical Sciænid.

Fam. 29. Mullidæ.

Spinous dorsal short, of 6 to 8 slender spines, well separated from the short soft dorsal, which is similar to the anal; 1 or 2 anal spines; caudal with 15 principal rays, 13 branched; pelvies thoracic, each of a spine and 5 soft rays, with a scaly axillary process. Two nostrils on each side. Gill-membranes free from the isthmus; 4 branchiostegals; 4 gills; pseudobranchiæ present. A pair of long barbels attached to the hyoid behind the symphysis of the lower jaw. Mouth protractile; villiform teeth in the jaws and often on vomer and palatines; præmaxillary rami long, without distinct posterior processes or expansions; maxillary rami usually broadest distally, not overlapped externally by the præmaxillaries, sheathed for the greater part of their length. Palatine without ridge. A strong subocular shelf. Occipital and parietal crests developed. Vertebrae 24 (10+14); all the præcaudals with parapophyses and all the ribs on parapophyses.

This family differs from the Lutianidæ in several characters of specialization.

Principal genera: *Mullus*, *Mulloides*, *Upeneus*, *Upeneoides*, *Upeneichthys*.

Fam. 30. Lethrinidæ.

Closely related to the Lutianidæ. Gill-membranes broadly united, but free from the isthmus. Anterior teeth villiform, with canines; lateral teeth conical or obtuse, in a single series; palate toothless. Præmaxillaries with rather long pedicels and short rami, the latter without posterior expansions or processes and with their distal ends internal to the maxillaries. Occipital crest strong; parietal crests strong or moderate. Vertebrae 24 (10+14), all the præcaudals with parapophyses, all the ribs, or all but the first, inserted on the parapophyses.

The three genera may be grouped thus:—

- I. Subocular shelf small, emitted by the second suborbital but mainly internal to the first; maxillary with a very broad posterior expansion below its articulation with the palatine; maxillary process of palatine normal; outer face of palatine with a prominent ridge which extends on to the pterygoid. *Pentapus*, *Sphærodon*.
- II. Subocular shelf vestigial, a minute process of the second suborbital at its junction with the first; maxillary with a moderately broad posterior expansion, which is overlapped by a flattish downwardly curved branch of the maxillary process of the palatine; outer face of palatine without ridge *Lethrinus*.

Fam. 31. Sparidæ.

Differ from the Lutianidæ especially in that the distal end of the præmaxillary ramus overlaps the maxillary externally. Mouth moderately protractile, the præmaxillary pedicels not or scarcely reaching the frontals; maxillary more or less expanded forward distally, but without distinct notch in its anterior edge; palate toothless. A strong subocular shelf, developed forwards from the second suborbital and mainly internal to the first. Occipital and parietal crests well developed. Vertebrae 24 (10 + 14).

The principal genera may be arranged thus:—

- I. Præcaudal vertebrae with parapophyses from the third; first rib sessile; teeth conical, with anterior canines.

Dentex.

- II. All the præcaudals with parapophyses and all the ribs on parapophyses.

- A. No canines: no transverse series of a few enlarged anterior teeth.

Teeth villiform, in bands, anteriorly acute, laterally conical or obtuse

Pagellus.

Teeth villiform or cardiform, in bands, the outer series compressed, lanceolate.

Gymnocrotaphus, Cantharus.

A single series of incisors

Bor, Scatharus.

Anteriorly a series of incisors with small obtuse teeth behind them; lateral teeth villiform

Oblata.

Two series of incisors and within them 2 or 3 series of molars

Crenidens.

- B. Anteriorly a transverse series of a few enlarged canines or incisors; laterally 2 to 4 series of molars.

Calamus, Stenotomus, Sparus, Pagrus, Diplodus, Chrysophrys.

Fam. 32. Mænidæ.

Closely related to the Sparidæ. Maxillary with a notch in its anterior edge for the reception of the distal end of the præmaxillary ramus; mouth very protractile, the præmaxillary pedicels extending to the occiput; small pointed teeth in the jaws and sometimes on the vomer. Subocular shelf quite small, developed forwards from the anterior end of the second suborbital. Occipital crest short, rather weak; parietal crests feeble. Vertebrae 24 (10 + 14); all the præcaudals with parapophyses and all the ribs on parapophyses.

Genera: *Mæna* and *Smaris*.

Fam. 33. Monodactylidæ.

This family includes 3 genera with the body deep and strongly compressed, the dorsal and anal long and covered with scales, the former preceded by 5 to 8 graduated spines, the latter by 3, and the pelvic fins small or even vestigial, inserted below the pectorals. Mouth normally formed, terminal, oblique, protractile, with small villiform teeth in the jaws and on the palate; maxillary exposed distally, without supramaxillary. Gill-membranes free from the isthmus. A strong occipital crest extending forward to the anterior margin of the frontals. Vertebrae 24 (10+14); præcaudals with parapophyses from the third or fourth; ribs, except the last pair, sessile, inserted behind and above the parapophyses.

The recently described *Bramichthys* (Waite, Rec. Austral. Mus. vi. p. 72, pl. xiv.) differs from *Monodactylus* in the cycloid scales, and in the normally formed pelvic fins with a scaly axillary process. *Monodactylus* has the body ovate or nearly circular and the pelvic fins very small, with a short stout spine and no axillary process; a subocular shelf is present and the pelvic bones are merely coalescent by their inner edges. *Psettus* differs not only in the very deep and abnormally formed body, but in the absence of a subocular shelf and the ankylosis of the pelvic bones.

The Eocene *Amphistium* may belong to this family.

Fam. 34. Pempheridæ.

Except for the shortness of the dorsal fin *Pempheris* shows considerable resemblance to the Monodactylidæ (especially *Bramichthys*) in external characters. The head-skeleton is very like that of *Monodactylus*, but the pectoral arch differs in the greater expansion of the hypocoracoids. The vertebrae number 24 (10+14), the caudals rather elongate; the anterior ribs are sessile, but the last 5 are inserted on well-developed parapophyses.

Fam. 35. Toxotidæ.

Dorsal rather short, above the anal, preceded by 5 strong spines; soft dorsal and anal scaly; pelvic fins well developed, below the pectorals, with scaly axillary process. Mouth rather large, terminal, oblique, protractile, with small villiform teeth in the jaws and on the palate; maxillary very

slender, without supramaxillary. No subocular shelf. Gill-membranes free from the isthmus. Head flattish above, with the occipital crest short and the parietal crests vestigial. Vertebrae 24 (10+14); præcaudals with parapophyses from the third; ribs, except the last pair, sessile, inserted behind and above the parapophyses.

Toxotes may be, in my opinion, rather closely related to the Monodactylidæ.

Fam. 36. Scorpionidæ.

Spinous dorsal well developed; soft dorsal and anal densely scaly; 3 anal spines; pelvies normally developed, with scaly axillary processes, well behind the pectorals, the pelvic bones elongate. Mouth moderately protractile, normally formed; maxillary more or less exposed distally, without supramaxillary; jaws with villiform or slightly compressed and lanceolate teeth in bands; teeth usually present on vomer and palatines. A subocular shelf. Vertebrae 25 (10+15); præcaudals with parapophyses from the third or fifth; ribs, except the last pair, sessile, inserted above and behind the parapophyses.

In *Scorpiis* the vertebrae number 25 (10+15), the præcaudals with parapophyses from the third; the strong occipital and parietal crests end at a transverse ridge which forms the posterior border of the frontals, which are rather strongly elevated posteriorly.

The skeleton of *Medialuna* is precisely similar to that of *Scorpiis*, and the two genera differ only in the dentition and in the form of the spinous dorsal. *Atypichthys* is very near *Medialuna*, but parapophyses commence on the fifth vertebra and the frontals are less elevated posteriorly. *Neatypus* and *Atyposoma* are the remaining genera of this family.

Fam. 37. Cyphosidæ.

Differs from the preceding especially in the absence of a subocular shelf and in the dentition, the jaws having an outer series of strong incisors implanted by horizontal roots, with a series of small villiform teeth behind them. Vertebrae 26 (10+26); præcaudals with transverse processes from the fourth; ribs, except the last, sessile; first epipleural expanded, laminar.

Genera: *Cyphosus*, *Sectator*, *Hermosilia*.

I have examined the skeleton of *C. boscii*, which is extremely similar to that of *Atypichthys*.

Fam. 38. Girellidæ.

Probably related to the Scorpididæ and Cyphosidæ, to which they bear a considerable resemblance. Mouth small; maxillary concealed beneath the præorbital and first sub-orbital; no supramaxillary; jaws with bands of incisors; palate toothless. A subocular shelf. Vertebrae 27 (11 + 16); all the præcaudals with parapophyses and all the ribs inserted on parapophyses.

I have examined the skeleton in *Girella*, *Melambaphes*, and *Doydirodon*, which differ in their osteology from the Scorpididæ only in the structure of the vertebral column and the attachment of the ribs. *Proteracanthus* is near *Doydirodon*, but has the gill-membranes broadly joined to the isthmus.

Tephraops, *Pachymepoton*, and *Dipterodon* probably pertain to this family.

Fam. 39. Ehippidæ.

Body deep, compressed. Soft dorsal and anal densely scaly; 3 anal spines; caudal of 17 principal rays, 15 branched. Gill-membranes broadly attached to the isthmus. Mouth small, terminal, not or scarcely protractile; jaws with bands of setiform teeth; palate toothless. An elevated occipital crest; no parietal crests. Vertebrae 24 (10 + 14); præcaudals with parapophyses from the fourth; ribs, except the last 2 pairs, sessile.

Ehippus has a distinct spinous dorsal and a broad subocular shelf. *Platax* and *Parapsyttus* have the dorsal spines graduated and the subocular shelf very feeble.

Fam. 40. Drepanidæ.

In general form, development of the vertical fin, dentition, structure of the skull, and vertebral column, similar to the Ehippidæ. Mouth protractile, with the maxillary exposed distally. No subocular shelf.

Fam. 41. Scatophagidæ*.

Body deep, compressed. Spinous dorsal well developed; anal spines 4; caudal of 16 principal rays, 14 branched; pelvic axillary process present. Gill-membranes forming

* Cf. Gill, Proc. U.S. Nat. Mus. xiii. 1891, p. 355.

a fold across the isthmus, to which they are narrowly attached. Mouth small, terminal, transverse, not protractile; jaws with bands of setiform teeth; palate toothless. An elevated occipital crest; no parietal crests; a subocular shelf. Vertebrae 23 (10+13); last 3 præcaudals with parapophyses; ribs sessile, inserted high up on the centra or on the bases of the neural arches.

Fam. 42. Chætodontidæ.

Body deep, compressed. Spinous dorsal well developed; soft dorsal and anal densely scaly; anal spines 3 or 4; caudal of 17 principal rays, 15 branched; pelvic axillary process present. Gill-membranes sometimes united, but free from the isthmus, more often narrowly attached to the isthmus. Mouth small, terminal, protractile; jaws with bands of setiform teeth; palate toothless. An elevated occipital crest: no parietal crests; a subocular shelf. Vertebrae 24 (10+14); præcaudals with transverse processes; ribs much expanded proximally, inserted on the transverse processes, with which they form an extended articulation.

Principal genera: *Chætodon*, *Chelmo*, *Heniochus*, *Holacanthus*, *Pomacanthus*.

Fam. 43. Enoplosidæ.

Enoplosus appears to be at least as closely related to the Histiopteridæ as to the Scorpionidæ. It resembles the Histiopteridæ in the large pelvic fins with long and strong spines placed below or slightly behind the pectorals, the short and broad pelvic bones, the occipital crest with the anterior edge thickened, the absence of parietal crests, &c. Mouth normally formed; maxillary exposed distally, with supra-maxillary; villiform teeth in jaws and on vomer and palatines; præorbital normally attached to lateral ethmoid, forming part of the border of the orbit; a subocular shelf. Vertebrae 26 (10+16); præcaudals with parapophyses from the fifth; ribs, except the last pair, sessile.

Fam. 44. Histiopteridæ.

Differs from the preceding especially in that the præorbital is displaced forward, not entering the orbit, and in the vertebral column, which comprises 25 vertebrae (13+12), the præcaudals with parapophyses from the fourth or fifth,

the ribs inserted on the parapophyses. There is no supra-maxillary and the external bones of the head are rugose, uncovered by skin.

Jordan (Proc. U.S. Nat. Mus. xxxii. 1907, p. 235) details the external characters of the family and gives a synopsis of the genera. I have examined the skeleton in *Histiopertus* and *Pentaceropsis*.

Fam. 45. *Pristolepidæ*.

Mouth small, moderately protractile, the præmaxillary pedicels not reaching the frontals. Jaws formed as in the Lutianidæ, with villiform teeth; teeth on vomer, palatines, and parasphenoid. Pseudobranchiæ absent; gill-membranes united. Spinous dorsal well developed; 3 anal spines; caudal of 14 principal rays, 12 branched. Lateral line interrupted. Vertebrae 25 or 26 (13-14+12); præcaudals with parapophyses from the third or fourth; ribs sessile, inserted above and behind the parapophyses.

This family includes two genera only, *Pristolepis*, Jerd., and *Badis*, Bleek. Both have a well-developed mesopterygoid, which in *Pristolepis* bears a patch of conical teeth. In *Pristolepis* the parasphenoid teeth are obtuse, rounded molars; they form a large patch in the roof of the mouth which is opposed to a similar group of teeth on the tongue; the first 3 suborbitals give rise to a rather broad subocular shelf, the supraoccipital and parietal crests are strong and the pelvic fin has a scaly axillary process. In *Badis* the parasphenoid teeth are conical and form a small group, which is placed posteriorly; the suborbitals are not ossified and there is no subocular shelf; the skull is smooth and rounded above, the occipital crest does not extend forward on to the frontals, parietal crests are not developed, and the pelvic fin has no scaly axillary process.

Fam. 46. *Nandidæ*.

Mouth large, very protractile, the præmaxillary pedicels long, lying in a hollow formed by the bifurcation of the occipital crest; distal extremity of præmaxillary ramus articulated to outer face of maxillary; maxillary exposed; no supramaxillary. Villiform teeth in the jaws and on vomer and palatines. Pseudobranchiæ absent; gill-membranes not united. Spinous dorsal well developed; anal spines 3 or 4; caudal of 14 or 16 principal rays, 12 or 14 branched; pelvic fin without scaly axillary process. Lateral

line interrupted. Vertebrae 23 (10-13+10-13); præcaudals with parapophyses from the seventh or eighth; last 2 to 4 pairs of ribs on parapophyses.

All the genera have a well-developed mesopterygoid. *Nandus* has 3 or 4 anal spines, a very small patch of teeth on the parasphenoid just in front of the upper pharyngeals, 13+10 vertebrae, and no subocular shelf.

Polycentrus and *Polycentropsis* have numerous anal spines, no parasphenoidal teeth, and 10+13 vertebrae. In *Polycentrus* the subocular shelf is narrow, in *Polycentropsis* it is a triangular lamina. *Monocirrus* is allied to *Polycentrus*.

Fam. 47. Hoplegnathidæ.

Probably related to the Lutianidæ and Lethrinidæ, from which they differ especially in that the mouth is non-protractile, the maxillaries are firmly attached to the præmaxillaries, and the teeth are fused to form a beak, much as in the Scaridæ. Præmaxillary rami short; maxillary with a large posterior expansion just below its palatine articulation; palatine normal. Subocular shelf developed forward from the second suborbital, but mainly internal to the first. Gill-membranes broadly united, but free from the isthmus. Pelvic fin with a scaly axillary process. Vertebrae 25 (10+15); præcaudals with parapophyses from the fourth; ribs, except the first, inserted on parapophyses.

Fam. 48. Cichlidæ.

Fins usually as in the Serranidæ and other generalized Perciformes. A single nostril on each side; lower pharyngeals attached by their inner edges or united by suture; no subocular shelf.

Fam. 49. Cepolidæ.

Body very elongate and strongly compressed; no lateral line. Dorsal and anal very long, without spinous rays, connected with the reduced caudal, of about 10 rays; pelvics scarcely in advance of the pectorals, each of a spine and 5 branched rays, without axillary process. Two nostrils on each side. Mouth protractile, terminal, oblique; jaws normally formed; maxillary exposed, without supramaxillary; villiform teeth in the jaws; palate toothless. Gill-membranes not united, free from the isthmus; 6 branchiostegals; 4 gills; pseudobranchiæ present. Subocular shelf absent

or very narrow. Occipital crest short, not prominent; no parietal crests. Vertebrae numerous, 65-100, equal in number to the dorsal rays (in *C. rubescens* 15 + 51); præcaudals with parapophyses from the eighth; ribs on parapophyses when these are developed.

Genera: *Cepola* and *Acanthocephala*.

The Cepolidæ are aberrant Serranidæ, and differ from that family in little but the absence of spinous rays in the vertical fins, the reduced caudal, the elongate form, and increased number of vertebrae.

Division 2. CIRRHITIFORMES.

I have already dealt with this group in a separate paper (Ann. & Mag. N. H. (8) vii. 1911, pp. 259-262).

The "pharyngognathous" fishes of the order Percomorphi form three well-marked and probably not specially related groups, which resemble each other in the ankylosis of the lower pharyngeals to form a single bone. Were it not for this all three would be included in the division Perciformes, since their external and anatomical characters are those of typical perciform fishes.

Division 3. DITREMIFORMES.

Lower pharyngeals ankylosed to form a triangular plate; second upper pharyngeals absent, third and fourth united. A subocular shelf. A single posteithrum on each side. Vertebrae 32 to 42 (13-19 + 19-23); first centrum rigidly united to skull; ribs sessile, attached to the centra above the parapophyses. Two nostrils on each side. Four gills.

This division includes but a single family, Ditremidæ, viviparous shore-fishes of the North Pacific.

Division 4. POMACENTRIFORMES.

Lower pharyngeals ankylosed to form a subtriangular plate; second upper pharyngeals distinct, third and fourth united. A subocular shelf. Two posteithra on each side. Vertebrae 26 (11 + 15); first centrum normally articulated with skull; ribs inserted in sockets at the distal extremities of transverse parapophyses. A single nostril on each side. 3½ gills.

This division also includes but a single family, the Pomacentridæ, littoral fishes of warm seas.

Division 5. LABRIFORMES.

Lower pharyngeals ankylosed; second upper pharyngeals united with third and fourth. No subocular shelf. Two postcleithra on each side. Vertebrae 23 to 53 (9-31 + 14-22); first centrum normally articulated with skull; ribs attached above and behind parapophyses, which usually bear them away from the centra. Two nostrils on each side. $3\frac{1}{2}$ gills.

Fam. 1. Labridæ.

Mouth protractile; præmaxillary pedicels well developed, usually extending to the frontals; dentary firmly attached to articular. Teeth in jaws usually separate. Dentigerous portion of lower pharyngeal ovate, triangular, Y-shaped or T-shaped, with conical, granular, or molariform teeth; upper pharyngeals similarly toothed, stout bones with concave upper surfaces supported by a pair of convex apophyses of the parasphenoid. Each pelvic fin of a spine and 5 branched rays. Vertebrae 23 to 41 (9-20 + 14-22); præcaudals with parapophyses; all the ribs on parapophyses (except in *Epibulus*).

Subfam. 1. JULIDINÆ.

Dorsal VIII-XI 9-14, the spines all similar. Anal II-III 9-14. Vertebrae 24 to 26 (9-10 + 15-16); all the ribs on parapophyses. Jaws with conical or compressed teeth, the anterior more or less enlarged and canine-like; lower pharyngeal triangular or Y-shaped, with conical or obtuse teeth. Frontals hollowed out anteriorly for reception of the præmaxillary pedicels: occipital and parietal crests not extending forward beyond middle of orbits.

The genera may be thus arranged:—

- I. Lateral line continuous; cheeks and opercles scaly; 9 to 11 dorsal spines *Pteragogus*, *Dymceria*, *Labrichthys*, *Labroides*.
- II. Lateral line interrupted; cheeks and opercles scaly; 9 dorsal spines. *Doratonotus*.
- III. Lateral line continuous; head naked; 8 or 9 dorsal spines. *Anampses*, *Hemigymnus*, *Julis*, *Leptojulis*, *Pseudojulis*, *Stethojulis*, *Platyglossus*, *Halichæres*, *Iridio*, *Guentheria*, *Coris*, *Cheilio*, *Gomphosus*.

Fishes of tropical and subtropical seas.

Subfam. 2. *Xyrichthyinæ*.

Dorsal IX 12, the two anterior spines flexible, often forming a separate fin. Anal III 12. Vertebrae 25 (9+16); all the ribs on parapophyses. Teeth in jaws conical, with anterior canines; lower pharyngeal triangular or Y-shaped, with conical teeth. Frontals not hollowed out anteriorly; parietal crests vestigial or absent.

Cymolutes, *Novaculichthys*, *Xyrichthys*, *Iniistius*, from tropical and subtropical seas.

Subfam. 3. *Cheilininæ*.

Dorsal IX-XI 9-11. Anal III 8-9. Vertebrae 23 (9+14); all the ribs on parapophyses. Teeth in jaws conical, with anterior canines; lower pharyngeal T-shaped, with conical or obtuse teeth. Frontals not hollowed out anteriorly; occipital and parietal crests strong, extending forward to above anterior margin of orbit. Mouth moderately protractile, the præmaxillary pedicels not reaching the frontals; hyopalatine bones normal.

Cheilinus, *Pseudocheilinus*, *Cirrhilabrus*, from the Indo-Pacific.

Subfam. 4. *Epibulinæ*.

Differ from the preceding in that the first 3 ribs are sessile and in the extraordinarily protractile mouth, the præmaxillary pedicels reaching the occiput and flattening out the occipital crest. The palatine is disconnected from the suspensorium, the pterygoid and mesopterygoid are absent, and the proximal end of the long slender quadrate is movably articulated with the præoperculum and the lower ends of the metapterygoid and symplectic.

Epibulus insidiator from the Indo-Pacific.

Subfam. 5. *Clepticinæ*.

Dorsal XII 10. Anal III 12. Vertebrae 27 (10+17). Mouth small, strongly protractile, feebly toothed. Lower pharyngeal small, Y-shaped; teeth of upper and lower pharyngeals confluent, forming vertical plates with denticulated edges.

Clepticus parrae, Schneid., from the West Indies.

Subfam. 6. *HARPINÆ*.

Dorsal XI–XIV 7–11. Anal III 9–14. Vertebrae 27–30 (11–13+16–17); all the ribs on parapophyses. Teeth in jaws conical, uniserial, with anterior canines; lower pharyngeal a subtriangular or T-shaped plate, broader than long, with blunt teeth forming a pavement. Frontals hollowed out anteriorly for reception of the præmaxillary pedicels; occipital crest strong and parietal crests well developed.

Lachnolaimus, *Harpe*, *Pinelometopon*, *Semicossyphus*, *Trochocopus*, *Decodon*, *Xiphochilus*, *Chærops*, from tropical and temperate seas.

Subfam. 7. *PSEUDODACINÆ*.

Dorsal XI 12. Anal III 14. Jaws anteriorly with two pairs of broad incisors; lateral teeth confluent to form a sharp-edged plate. Lower pharyngeal an ovate plate with concave upper surface, much longer than broad, with several series of obtuse teeth forming a pavement and with a short anterior stem bearing a single series of 3 conical teeth.

Pseudodax moluccanus, Cuv. & Val., from the Indian Ocean and Archipelago, seems not very remote from *Chærops*.

Subfam. 8. *LABRINÆ*.

Dorsal XIII–XXI 8–14, the spines pungent. Anal III–VI 7–11, not longer than the soft dorsal. Vertebrae 31–41 (13–20+18–22); all the ribs on parapophyses. Jaws with conical teeth increasing in size anteriorly; lower pharyngeal a subtriangular plate, with the teeth acutely or obtusely conical. Frontals hollowed out anteriorly for reception of the præmaxillary pedicels; occipital and parietal crests well developed.

Labrus, *Crenilabrus*, *Ctenolabrus*, *Tautogolabrus*, *Tautoga*, *Acantholabrus*, *Centrolabrus*, from the North Atlantic and Mediterranean.

Subfam. 9. *MALACOPTERINÆ*.

Dorsal XVIII 14, the spines flexible. Anal III 18, longer than soft dorsal. Teeth in jaws conical, uniserial, enlarged anteriorly.

Malacopterus reticulatus, Cuv. & Val., from Chile.

Fam. 2. *Odacidæ*.

Mouth non-protractile, but jaws formed as in the Labridæ;

teeth in jaws coalescent, forming a sharp-edged plate; pharyngeals as in the Labridæ; pharyngeal teeth granular, forming a pavement. Dorsal spines flexible, numerous (16 to 24); each pelvic fin of a spine and 4 soft rays. Scales small or moderate; lateral line continuous. Skull flattish above, with a more or less distinct interorbital depression for the reception of the præmaxillary pedicels; a short occipital, but no parietal crests. Vertebrae 36 to 53 (19-31 + 17-22); all the ribs on parapophyses.

Four genera: *Olistherops*, *Coridodax*, *Odux*, and *Siphonognathus*, from the coasts of Australia and New Zealand. *Siphonognathus* is a remarkable type, very elongate, with the head like that of a *Fistularia*, and without pelvic fins.

Fam. 3. Scaridæ.

Mouth non-protractile; maxillary firmly attached to præmaxillary; dentary movably articulated with articular; jaws short and powerful, with the teeth united to form a pair of sharp-edged plates, recalling the beak of a parrot. Denti-gerous portion of lower pharyngeal quadrangular, with longitudinal series of transversely expanded linear teeth forming a pavement; upper pharyngeals similarly toothed, produced upwards into vertical plates with thickened convex upper edges moving backwards and forwards in a pair of grooves on the parasphenoid. Scales large, about 25 in a longitudinal series; lateral line abruptly decurved or interrupted posteriorly. Dorsal fin of 9 spines and 10 or 11 soft rays, anal of 2 or 3 spines and 8 to 10 soft rays, pelvics of a spine and 5 soft rays. Skull with occipital crest strong and parietal crests well developed. Vertebrae 25 (9-10 + 15-16); all the ribs on parapophyses.

Scarus, *Pseudoscarus*, *Callyodon*, *Sparisoma*, &c., shore-fishes of the tropics.

Division 6. GADOPSIFORMES.

Fam. Gadopsidæ.

Gadopsis scarcely differs from the Perciformes in osteology, but there is no mesopterygoid and there are 2 radials on the hypercoracoid and 2 on the hypocoracoid. The pelvic fins are jugular, each reduced to a small spine and a bifid ray. Against Bleennioid relationships are the intervention of the prootic between parasphenoid and alisphenoid, the 3 anal spines, the dorsal and anal rays more numerous

than the corresponding myotomes. Vertebrae 21 + 26; ribs, except the first 2 or 3, on strong parapophyses.

Division 7. TRICHODONTIFORMES.

This division includes a single family, differing from the Perciformes in the pectoral fin-skeleton.

Fam. Trichodontidæ.

This family includes 2 genera, *Trichodon* and *Arctoscopus*, related to the Perciformes. The external characters are given by Jord. & Everm. (Bull. U.S. Nat. Mus. xlvii. p. 2295, figs. 806, 807). The principal osteological characters of *Trichodon trichodon* are as follows:—Skull flattish above, without crests or ridges on upper surface; suborbitals ossified, without subocular shelf; jaws normally formed, the maxillary broadest distally, without supramaxillary; mesopterygoid vestigial or absent; head skeleton otherwise apparently Perciform. Post-temporal forked; hypercoracoid and hypocoracoid separated; radials 4, rather large and laminar, only the uppermost on the hypercoracoid. Pelvic bones rather long and narrow. Vertebrae 49 (17 + 32); posterior præcaudals with parapophyses; ribs on parapophyses when these are developed.

Division 8. AMMODYTIFORMES.

Fam. Ammodytidæ.

Body elongate, naked or scaly. Vertical fins without spines, the dorsal rays nearly equal in number to the vertebrae below them, the caudal of 15 principal rays, 13 branched; pectorals rather low; pelvic fins, when present, jugular, very small, of a spine and 3 soft rays. Snout rather long and pointed; eyes lateral; mouth protractile, terminal, with the lower jaw prominent; præmaxillary slender; maxillary not exposed, without supra-maxillary, proximally with an anterior expansion or process, which meets its fellow above the short præmaxillary pedicels; teeth in jaws minute or absent; palate toothless. Gill-membranes free from the isthmus; 4 to 8 branchiostegals; 4 gills; pseudobranchiæ. Head-skeleton normally Percoid as regards number and arrangement of bones; suboperculum very large, projecting considerably beyond

operculum; skull long, flattish above, with a short occipital and no parietal crests; nasals long, nearly or quite meeting above the mesethmoid; no subocular shelf. Pectoral arch Perciform, the 4 radials normally hourglass-shaped, only the lowest on the hypocoracoid. Vertebrae 69 (40 + 29) in *Ammodytes lanceolatus*; first very short, with the centrum convex anteriorly, fitting the single concavity formed by the basioccipital and exoccipitals; latter meeting above the former; ribs blade-like, anteriorly sessile, posteriorly on short parapophyses; epipleurals mostly on ribs.

Genera: *Embolichthys*, *Bleekeria*, *Ammodytes*, *Hyperoplus*, *Hypoptychus*.

The systematic position of this family has been the cause of considerable discussion. Boulenger interpreted the Oligocene *Cobitopsis*, with abdominal pelvic fins, as a member of this family. After examination of the examples of *Cobitopsis acutus* in the British Museum collection I have doubt that this fish is a congener of the existing Scombresocid, *Chriodorus atherinoides* of the coasts of Florida.

I have carefully examined a spirit-specimen of *Bleekeria callolepis* and compared it with *Ammodytes*; the two genera are very closely related, and *Embolichthys*, Jordan, scarcely differs from *Bleekeria* except in the presence of jugular pelvic fins.

The nearest allies of the Ammodytidae among the Percoids seem to be the Percophiidae; but the relationship is not very close, and the Ammodytidae may well form a separate division, Ammodytiformes.

Division 9. CHAMPSODONTIFORMES.

Fam. Champsodontidae.

Champsodon differs from the Trachiniformes in that the small pectoral fin has the base oblique; the radials are elongate hourglass-shaped, 3 on the hypercoracoid, which is quite narrow and is pierced by a small foramen, and 1 on the hypocoracoid. Spinous dorsal short, separate; soft dorsal and anal long; pelvics large, close together, well in advance of the pectorals. Mouth oblique; maxillary exposed; cardiform teeth in jaws and in two separate patches on vomer. Gill-membranes separate, free. No mesopterygoid. Bones of skull arranged as in normal Perciformes. Skull depressed, flat above, expanded behind the orbits. Vertebrae 31 (12 + 19); præcaudals with parapophyses from the

fourth; ribs on parapophyses when these are developed; epipleurals attached near insertion of ribs.

Centropercis nudivittis, Ogilb., 1895 (Waite, Mem. Austral. Mus. iv. 1, 1899, pl. xi. fig. 2), is evidently closely related to *Champsodon*.

Division 10. TRACHINIFORMES.

This is an unsatisfactory and perhaps artificial assemblage of families. The dorsal and anal fins are more or less elongate, the latter preceded by only 1 or 2 feeble spines, the pectorals have vertical bases and the pelvics, inserted below or in advance of the pectorals, have the middle or inner rays longest. The head-skeleton is Perciform, but a constant feature is the absence of well-marked crests on the upper surface of the skull. The pectoral radials are 3 or 4 in number, the 2 lowest inserted on the hypocoracoid. For the whole or the greater part of the length of the soft dorsal fin there is one ray to each myotome.

Fam. 1. Opisthognathidæ.

Lateral line single, running high, incomplete, ending near middle of dorsal fin. Dorsal continuous, with the spinous and soft-rayed portions subequal; anal with 2 spines; caudal with 14 or 15 principal rays, 12 or 13 branched; pelvics in advance of the pectorals, close together, each of a spine and 5 soft rays, without scaly axillary process. Mouth terminal, nearly horizontal, protractile; jaws normally formed; maxillary broad, exposed, with supra-maxillary; villiform or cardiform teeth in jaws and sometimes on vomer. Two nostrils on each side. Gill-membranes free from the isthmus; 6 branchiostegals; 4 gills; pseudobranchiæ present. A narrow subocular shelf. Skull narrow between and expanded behind the orbits; postorbital part evenly convex above; occipital crest only on the posterior face of skull, which is long and oblique; no parietal crests; exoccipital condyles separate; prootics forming a roof for myodome and basisphenoid present. Foramen in hypercoracoid; radials rather broad and flat, 2 on hypercoracoid and 2 on hypocoracoid. Vertebrae 29 (10 + 19); præcaudals with parapophyses from the fifth; 3 ribs sessile, 5 on parapophyses; epipleurals on ribs.

Principal genera: *Gnathypops*, *Stalix*, *Opisthognathus*.

Fam. 2. Bathymasteridæ.

Lateral line terminating near end of the many-rayed dorsal fin, which has only a few spines anteriorly; no supra-maxillary; vomerine and palatine teeth. No subocular shelf from the second suborbital, but the first and the præ-orbital form a shelf for attachment to the lateral ethmoid. Prootics not forming a roof for the myodome; no basi-sphenoid. Vertebrae 49 to 52 (14-15 + 35-37); præcaudals with parapophyses from the third; ribs, except the first, on parapophyses. In other characters similar to the Opisthoguathidæ, to which they are closely related.

Principal genera: *Bathymaster*, *Rathbunella*.

Fam. 3. Pinguipedidæ.

Lateral line complete, continuous. Dorsal fin elongate, continuous, with a few spines anteriorly; rays equal in number to the vertebrae below them, each basal attached to its own neural spine. Anal long, with 2 spines. Caudal with 15 or 17 principal rays, 13 or 15 branched. Pelvics below or somewhat in advance of the pectorals, fairly wide apart, each of a spine and 5 branched rays, without scaly axillary process. Mouth protractile, terminal, slightly oblique; jaws normally formed; maxillary concealed, without supra-maxillary; teeth in jaws villiform, with canines; teeth on vomer and usually on palatines. Two nostrils on each side. Gill-membranes united, free from the isthmus; 6 branchiostegals; 4 gills; pseudobranchiæ present. No subocular shelf. Skull flatfish above, rather strongly expanded behind the orbits, the sphenotics with prominent projections; occipital crest short and parietal crests indistinct or absent; exoccipital condyles well separated; a basi-sphenoid. Foramen in hypercoracoid (*Pinguipes*) or between it and hypocoracoid (*Parapercis*); radials hour-glass-shaped, 4 in number, 2 on hypocoracoid; postcleithra laminar, 2 on each side. Vertebrae 30-38 (10-16 + 20-22); præcaudals with parapophyses from the third; all the ribs, or all but the first, on parapophyses; epipleurals attached to parapophyses or to ribs near their insertion.

Principal genera: *Pinguipes*, *Parapercis*, *Neopercis*.

Fam. 4. Chimarrichthyidæ.

Chimarrichthys, with a single species from mountain torrents of New Zealand, differs from the Pinguipedidæ

in that the pelvic fins are somewhat more advanced and wider apart, and the mouth is non-protractile and inferior. Pectoral arch much as in *Pinguipes*, but the radials squarish. Vertebrae 33 (*vide* Waite, Trans. N.Z. Inst. xlii. 1909, p. 390).

Fam. 5. Trachinidæ.

Fins as in the Pinguipedidæ, except that the caudal has 13 principal rays, 11 branched, and the pelvic fins are close together and well in advance of the pectorals. Mouth oblique, maxillary exposed, subocular shelf well developed and mesopterygoid broad. Foramen between hyper- and hypocoracoid; radials very short, 2 on hyper- and 2 on hypocoracoid. Vertebrae 42 (12+30); præcaudals with parapophyses from the eighth; ribs and epipleurals inserted together, on parapophyses when these are developed. In other characters resembling the Pinguipedidæ.

A single genus, *Trachinus*.

Fam. 6. Percophiidæ.

Lateral line complete, continuous. Spinous dorsal separate, of a few slender spines; soft dorsal and anal very long; rays of soft dorsal equal in number to the vertebrae below them, each basal attached to its own neural spine; one anal spine; caudal with 15 principal rays, 13 branched; pelvics in advance of the pectorals, wide apart, each of a spine and 5 branched rays, without scaly axillary process. Mouth terminal, oblique, protractile; jaws normal; maxillary exposed, without supramaxillary; teeth in jaws cardiform, with canines; teeth on vomer and palatines. Two nostrils on each side. Gill-membranes not united, free from the isthmus; 7 branchiostegals; 4 gills; pseudobranchiæ present. A subocular shelf; mesopterygoid broad; skull much as in *Trachinus*, but more depressed, with the exoccipitals united behind the supraoccipitals, forming a roof for the *foramen magnum*. Pectoral arch as in *Pinguipes*, the radials a little shorter. Vertebrae 77 (22+35); posterior præcaudals with short parapophyses; ribs and epipleurals mostly sessile, inserted together, the latter the stronger.

Fam. 7. Bemprosidæ.

This family includes two closely related genera, *Bemdrops* (*Hypsicometes*) and *Chrionema*, with short, separate spinous

dorsal, rather long soft dorsal and anal, no anal spines, caudal with 10 or 11 branched rays, and pelvics well separated, jugular, each of a spine and 5 soft rays. Body scaly; lateral line descending anteriorly, for most of its course nearer anal than dorsal fin. Gill-membranes not united, free from isthmus; opercular membrane produced; 7 branchiostegals; 4 gills; pseudobranchiæ. Eyes large; interorbital region narrow; suborbitals unossified; snout broad, depressed; mouth terminal, protractile, with the lower jaw prominent; maxillary exposed; villiform teeth in jaws and on vomer and palatines. In *Bembrops* the hypercoracoid is perforate and there are 3 radials, corresponding in form and position to the 3 lower radials of *Parapercis*.

Fam. 8. Hemerocætidæ.

Body scaly; lateral line running along middle of side. Spinous dorsal, if present, short; soft dorsal and anal long; no anal spines; caudal of 10 principal rays, 8 branched; pelvics jugular, well separated, each of a spine and 5 branched rays. Mouth protractile, terminal, with the lower jaw somewhat the shorter; maxillary slightly exposed distally, without supramaxillary, with a forwardly directed spine just in front of the præorbital; villiform teeth in the jaws and in 2 separate patches on the vomer; none on the palatines. Eyes rather large and close together; suborbitals well ossified. Gill-membranes not united, free from isthmus; 6 branchiostegals; 4 gills; pseudobranchiæ. Head-skeleton as in the Pinguipedidæ, but no basisphenoid and no prominent sphenotic process; pectoral arch similar, but a large foramen between hypercoracoid and hypocoracoid and uppermost radial completely fused with the former. Vertebrae (in *Hemerocætes*) 48 (13+35); præcaudals with parapophyses from the fifth; ribs not ossified, but a series of epipleurals.

Two genera: *Acanthaphritis* (*Pteropsaron*) and *Hemerocætes*.

Fam. 9. Trichonotidæ.

Body scaly; lateral line running along middle of side. Dorsal long, with a few unarticulated rays anteriorly; anal long, with a feeble spine; caudal of 13 principal rays, 11 branched; pelvics jugular, separated by a narrow interspace, each of a spine and 5 branched rays. Mouth protractile, terminal, with the lower jaw projecting; maxillary not or

scarcely exposed, without spine; villiform teeth in jaws and on vomer and palatines. Eyes close together; suborbitals well ossified. Gill-membranes not united, free from isthmus; 7 branchiostegals; 4 gills; pseudobranchiæ. Head-skeleton and pectoral arch much as in *Hemerocates*. Vertebrae 53 (23 + 30); only the last 4 præcaudals with parapophyses; ribs and epipleurals sessile, inserted together.

Trichonotus and *Tæniolabrus*.

Fam. 10. *Creediidæ*.

Body elongate, scaly; lateral line running very low. Vertical fins without spines; dorsal, of 12 or 13 rays, placed above and much shorter than the anal, which has 26 or 27; caudal with 10 principal rays, 8 branched; pelvics jugular, narrowly separated, each of a spine and 4 soft rays. Snout conical; eyes close together; suborbitals well ossified; mouth protractile, terminal, with the lower jaw the shorter; small pointed teeth in the lower jaw; upper jaw and palate toothless. Gill-membranes not united, free from isthmus; 7 branchiostegals; 4 gills; pseudobranchiæ. Hypercoracoid with a small foramen near its lower margin.

This family is related to the preceding; it includes but a single species. This remarkable little fish, *Creedia clathrisquamis*, Ogilby, 1898, from the coasts of New South Wales and Victoria, is represented in the British Museum by a specimen of 70 mm. from Port Phillip, Victoria. This agrees with the type and differs from the example figured by Waite (Mem. Austral. Mus. iv, 1, 1899, p. 63) in that the præmaxillaries form a fleshy projection in front of the mouth; the absence of this projection in Waite's example is probably due to an accident, or possibly to a congenital malformation; it is unlikely that it is a sexual character.

Fam. 11. *Limnichthyidæ*.

Body elongate, scaly; lateral line complete, running low posteriorly. Vertical fins without spines; dorsal, of 19 to 26 rays, placed above the anal, which has 27 to 29; caudal with 12 principal rays; pelvics jugular, close together, each of a spine and 5 branched rays. Snout conical; eyes close together; mouth protractile, terminal, with the lower jaw the shorter; villiform teeth in jaws and on palatines. Gill-openings wide, the membranes free from isthmus; 7 branchiostegals.

Two genera, each with a single species, from Eastern Australia, may be distinguished thus:—

Dorsal 25-26, slightly shorter than anal; pectoral normal; vomer toothless	<i>Linnichthys</i> .
Dorsal 19, shorter than anal; pectoral with lower rays thickened and modified; vomer toothed.....	<i>Schizochirus</i> .

These fishes have been described by Waite (Rec. Austral. Mus. v. 1904, pt. 3, p. 178, pl. xxiii. fig. 4, and pt. 4, p. 241, pl. xxvi. fig. 3).

Fam. 12. Leptoscopidæ.

Body elongate, moderately compressed or cylindrical, scaly; lateral line complete, running along middle of side. Vertical fins without spines, the dorsal and anal long, with the rays equal in number to the vertebræ below or above them; caudal of 12 or 13 principal rays; pectorals broad-based; pelvics well separated, in advance of the pectorals, each of a spine and 5 branched rays. Mouth protractile, terminal, very oblique, with the lower jaw prominent; præmaxillary ramus with a posterior expansion at its distal end; maxillary exposed, without supramaxillary, broadest distally; jaws with villiform teeth. Head covered with skin. Gill-membranes free from isthmus; 6 branchiostegals; 4 gills; pseudobranchiæ; opercular bones normal; suborbitals ossified, without subocular shelf. No mesopterygoid; metapterygoid large, articulating with sphenotic. Skull depressed, flattish above; parietals separated by supra-occipital; a short occipital and no parietal crests; exoccipital condyles widely separated; no basisphenoid. Post-temporal forked, normally attached; hypercoracoid and hypocoracoid broad; foramen in hypercoracoid; radials 4, short and broad, rigidly attached, $2\frac{1}{2}$ on hypocoracoid; pelvic bones flat, horizontal. Vertebræ 43-46 (10 + 33-36); præcaudals gradually increasing in length to the eighth; parapophyses absent or vestigial; no ribs, but a series of eipleurals.

The two genera, from the coasts of Australia and New Zealand, may be distinguished thus:—

Teeth in jaws, in 2 separate patches on vomer and on palatines.	<i>Leptoscopus</i> .
Palate toothless; head broad; eyes superior	<i>Crapatalus</i> .

Fam. 13. Uranoscopidæ.

Body moderately elongate, cylindrical, naked or scaly; lateral line running high. A short spinous dorsal often

present; soft dorsal and anal moderately long; pelvics narrowly separated. Head broad, with the eyes superior; mouth terminal, nearly vertical, with the lower jaw prominent; villiform teeth in jaws, in 2 separate patches on vomer, and on palatines. Bones of head exposed; præ-orbital and first suborbital forming a shelf; operculum large and suboperculum small. Mesopterygoid present, but small and narrow; metapterygoid large, but not reaching sphenotic. Parietals meeting above supraoccipital. Upper fork of post-temporal laminar, rigidly united to skull; radials still shorter than in the *Leptoscopidæ*, united to hypercoracoid and hypocoracoid by suture or ankylosis. Pelyic bones erect, vertical laminae. Vertebrae 26-30 (11-12+16-18); first moderately long, firmly attached to skull; præcaudals increasing in length from the second and third, which are very short, to about the seventh; præcaudals with parapophyses from the sixth; ribs present, anteriorly attached to under surface of epipleurals, posteriorly on parapophyses.

In other characters similar to the *Leptoscopidæ*, to which they are closely related.

Division 11. NOTOTHENIIFORMES.

I have recently characterized this group and made a revision of the species (*Trans. R. Soc. Edinburgh*, xlix, 1913, pp. 249-289).

Division 12. CALLIONYMIFORMES.

The peculiarities of the skeleton of the head and of the pectoral arch and the reduced number of vertebrae warrant the recognition of a separate division for the *Callionymidæ*. This family may be related to the *Pinguipedidæ*, but is much more specialized. The *Gobiesocidæ* differ in many characters of importance.

Fam. 1. *Callionymidæ*.

Body naked; lateral line present. Spinous dorsal separate, of 3 or 4 slender flexible spines; anal similar to soft dorsal, without distinct spine, with 7 to 12 rays; caudal with about 10 principal rays; pelvics in advance of the pectorals, wide apart, each of a spine and 5 branched rays. Mouth protractile, terminal, horizontal, the lower jaw not prominent;

præmaxillary ramus without posterior expansion ; maxillary concealed, without supramaxillary ; small teeth in the jaws, none on the palate. Gill-membranes broadly joined to the isthmus ; 6 branchiostegals ; 4 gills ; pseudobranchiæ. Præoperculum with a strong spine at the angle ; operculum normal. Suborbitals ligamentous ; no mesopterygoid or metapterygoid ; skull depressed, narrowed between and expanded behind the orbits ; sphenotic with a curved projection, as in the Pinguipedidæ ; occipital crest short and parietal crests absent ; exoccipital condyles widely separated ; no basisphenoid ; mesethmoid ossified as an interorbital septum. Post-temporal forked, but forming an integral part of the skull ; supracleithrum slender, nearly horizontal, and directed outwards ; postcleithrum a single slender rod ; foramen between hypercoracoid and hypocoracoid ; radials large, flat, 3 in number, all on the hypocoracoid. Vertebrae 21 (7+14), compressed, especially posteriorly ; neural spines below the dorsal fin and hæmal spines above the anal bifid for reception of the basalia ; no ribs ; præcaudals, except the first, with long epipleurals, the anterior sessile, the posterior ones on short parapophyses.

Principal genera : *Callionymus*, *Synchiropus*, *Dactylopus*.

Fam. 2. Draconettidæ.

Evidently related to the Callionymidæ, with which they agree in the number of vertebrae, as I have ascertained by counting the myotomes in *Centrodraco* * *acanthopoma*, Rgn. This species, from the North Atlantic, differs from *Draconetta* of the North Pacific in that the dorsal spines are stout and pungent, the second much the longest, and in the presence of a single series of teeth on vomer and palatines. I have ascertained that the pectoral radials are large, elongate as in *Callionymus*. The family differs externally from the Callionymidæ in the absence of a lateral line, the entire præoperculum, and the reduction of the operculum and suboperculum to a pair of strong spines ; in the last feature these fishes resemble *Harpagifer*.

* This generic name is here proposed for the first time.